

# EU-GCC Clean Energy Network RE Policy Expert Workshop - MASDAR

## Renewable Energy Policy Experts Workshop

26<sup>th</sup> - 27<sup>th</sup> MASDAR Institute, Abu Dhabi, UAE

- EU-GCC co-operation potential in the field of  
Renewables: Technology and Research perspective

**Jürgen Kern**

German Aerospace Center Knowledge for Tomorrow  
Deutsches Zentrum für Luft und Raumfahrt e.V. (DLR)



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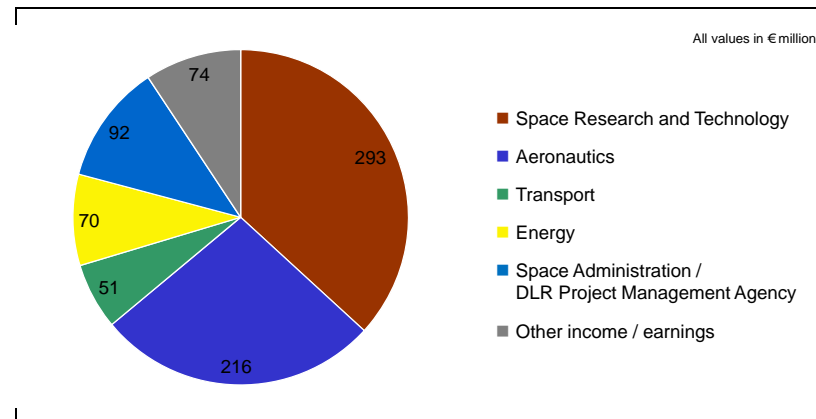
## Research Areas

- Aeronautics
- Space Research and Technology
- Transport
- Energy
- Space Administration
- Project Management Agency



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## Total income 2011 – Research, operations and management tasks (excluding trustee funding from the Space Administration / DLR Project Management Agency): €796 Mio.



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## Participation in the Helmholtz Association

- Success in obtaining program-oriented funding
- Added value from support of the Helmholtz Association
- Helping to shape the organisational development process



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## Energy Program Themes

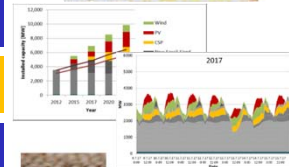
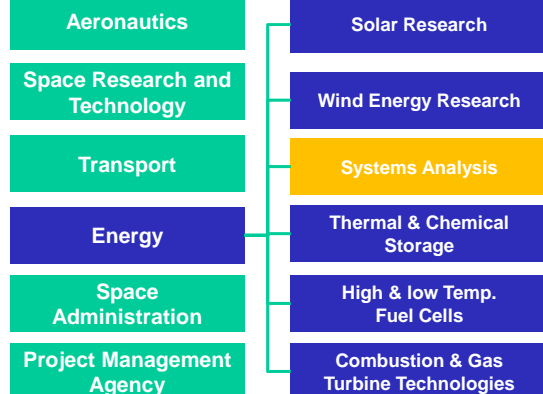
- Efficient and environmentally compatible fossil-fuel power stations  
(turbo machines, combustion chambers, heat exchangers)
- Solar thermal power plant technology, solar conversion
- Thermal and chemical energy storage
- High and low temperature fuel cells
- Systems analysis and technology assessment
- Plataforma Solar de Almería (PSA)



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## DLR - Who we are

Research Areas





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## Projects and Milestone



▪ MED-CSP	<a href="http://www.dlr.de/tt/med-csp">www.dlr.de/tt/med-csp</a>	2005
▪ TRANS-CSP > DESERTEC	<a href="http://www.dlr.de/tt/trans-csp">www.dlr.de/tt/trans-csp</a>	2006
▪ AQUA-CSP	<a href="http://www.dlr.de/tt/aqua-csp">www.dlr.de/tt/aqua-csp</a>	2007
▪ MED-CSD		2008-2010
▪ <b>EU GCC Clean Energy Network</b>		<b>2010-</b>
▪ ...		
▪ Renewable Energy Policy Experts Workshop		today
▪ CSP Finance		2011
▪ World Bank MENA Water Outlook		2011
▪ IRENA Solar Atlas		2010-2013
▪ BETTER		2012-
▪ Bringing Europe and Third countries closer Together trough Renewable Energies		
▪ QatDLR		2012-
▪ DLR-KA.CARE Cooperation on CSP Research		2013-

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## Overview

- [Energy, Renewables and Solar Power](#)
- [Transformation of the Energy System towards Sustainability](#)
- [Seawater Desalination with Concentrating Solar Power](#)
- [Renewable Energy Resource and Site Assessment](#)
- [Renewable Energy Expansion and Unit Commitment Model REMix-CEM](#)
- [Flexible, High Value Solar Power Exports](#)
- Fields of EU-GCC R&D Activities

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## Energy, Renewables and Solar Power



## Energy

Shortage of energy ?

- 25 cm crude oil annually on the hole surface of earth
- 2 millions barrels per square kilometer



Knowledge for Tomorrow  
Energy for Tomorrow



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## Renewable Energy for Power Generation

Wind Power (Enercon)

Hydropower (Tauernkraft)

Solar Chimney (SBP)

Photovoltaic (NREL)

Hot Dry Rock (Stadtwerke Urach)

Biomass Power (NREL)

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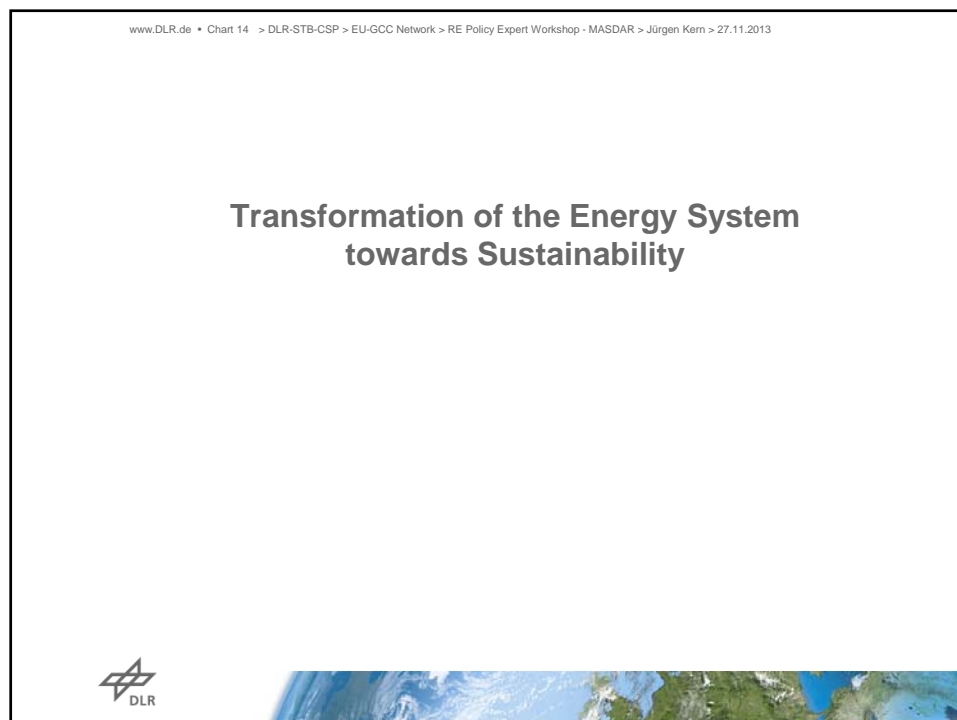
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## Solar Power Technologies

Market available Technology	proofed since 1986

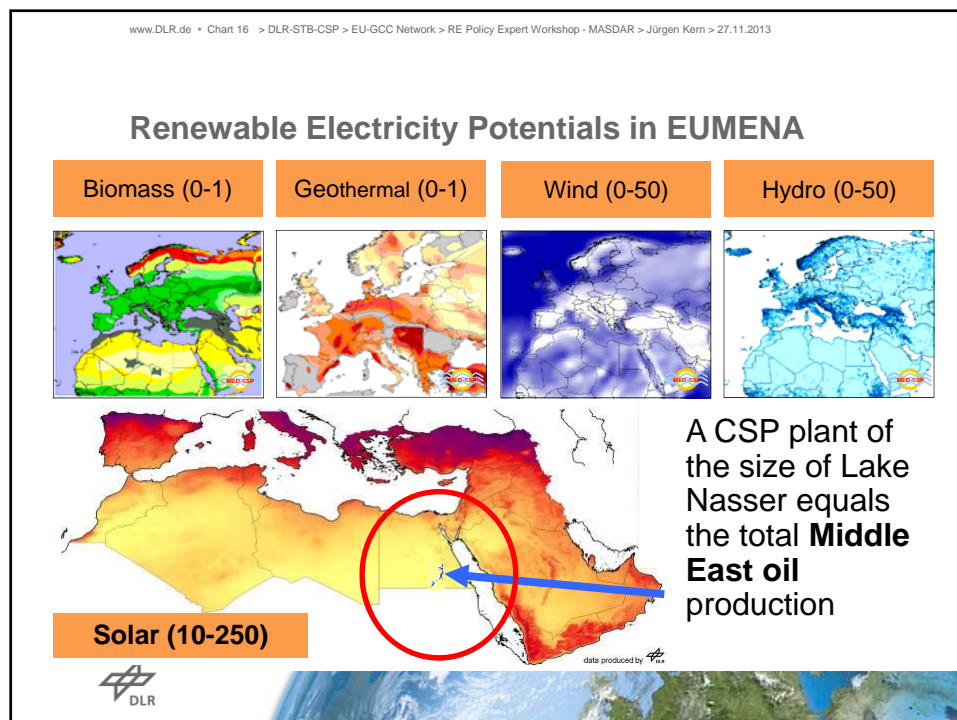
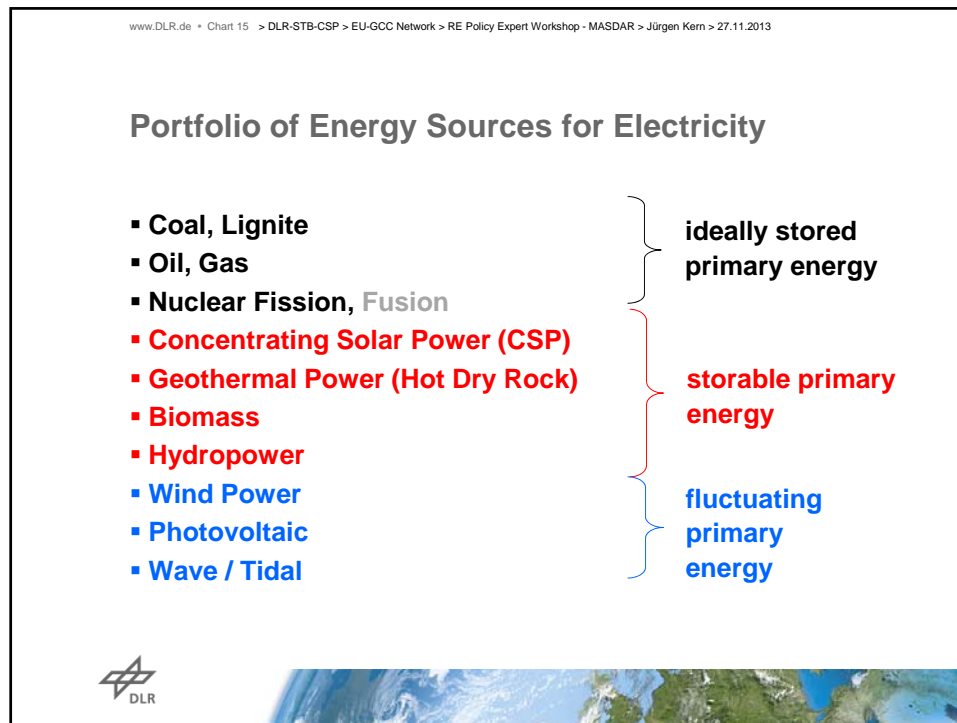
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# EU-GCC Clean Energy Network

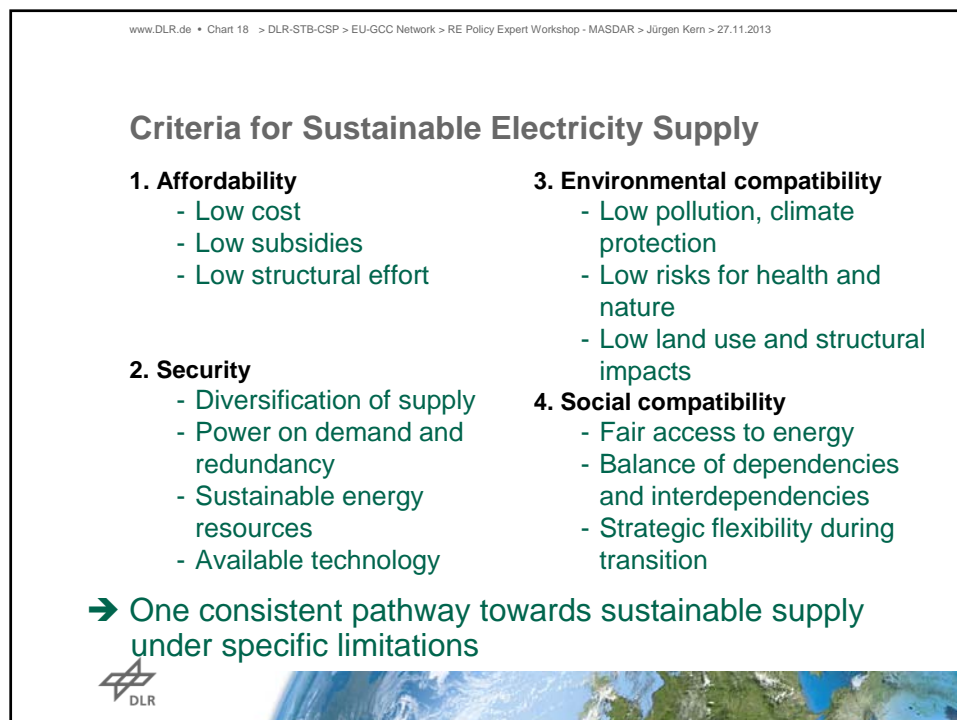
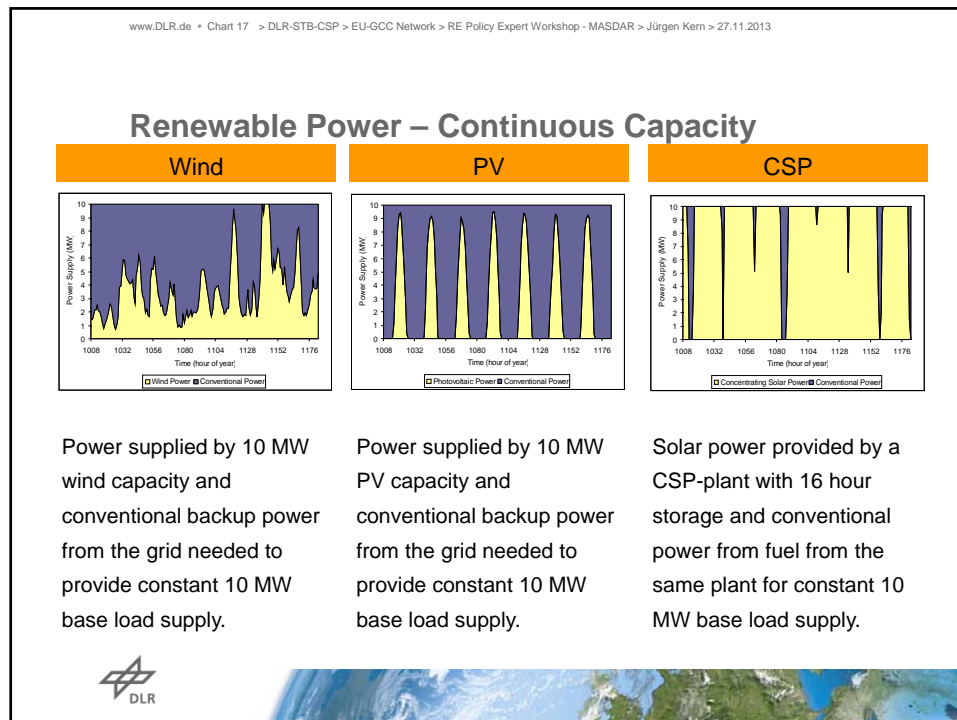
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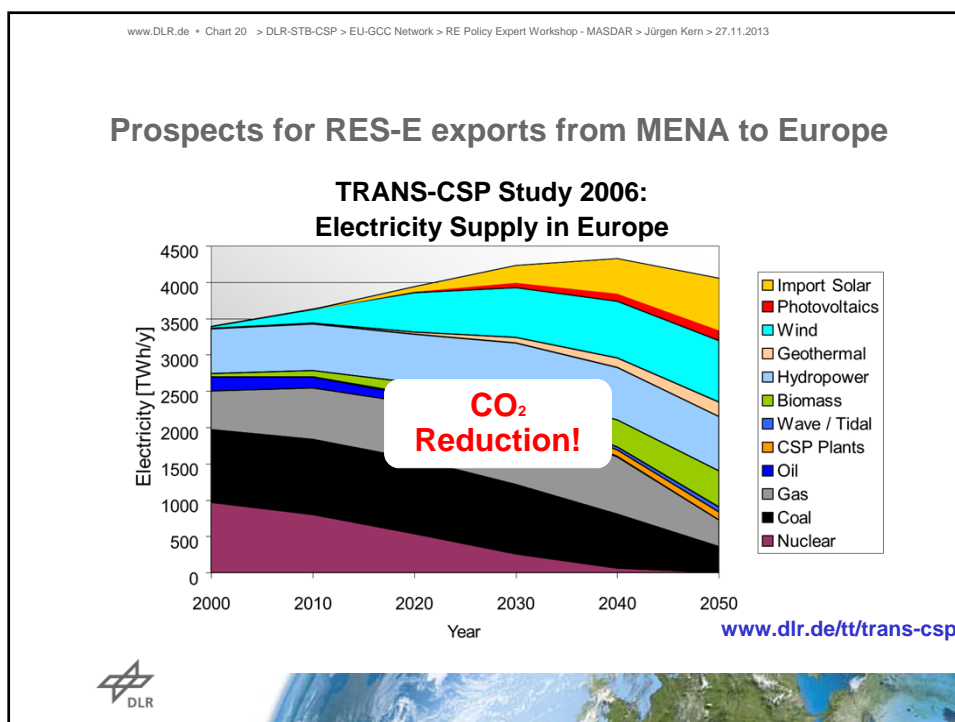
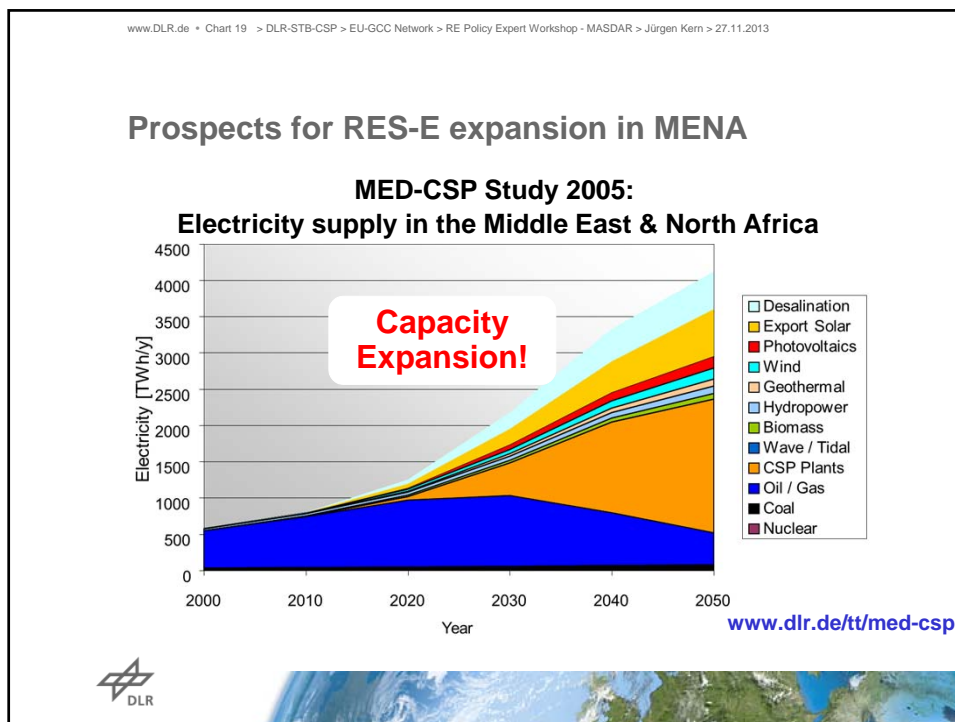
# EU-GCC Clean Energy Network

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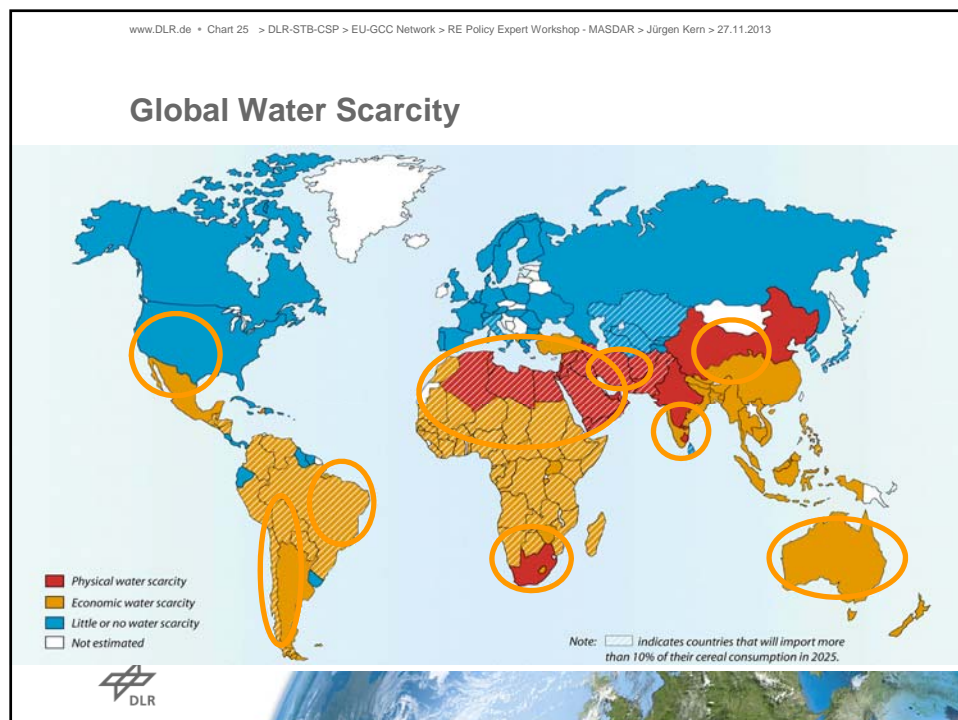
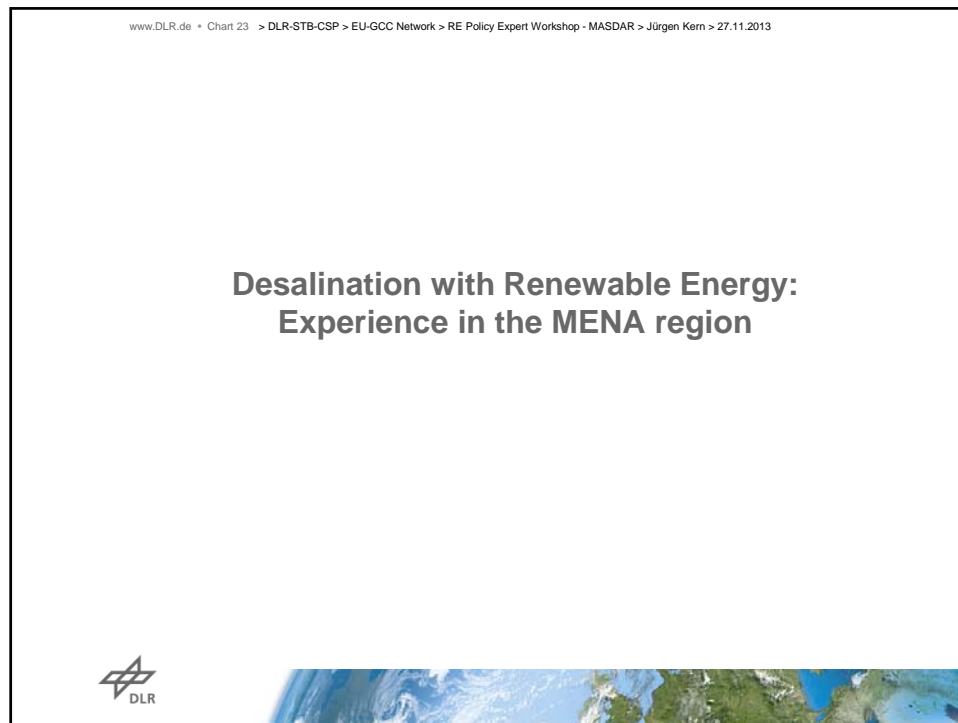


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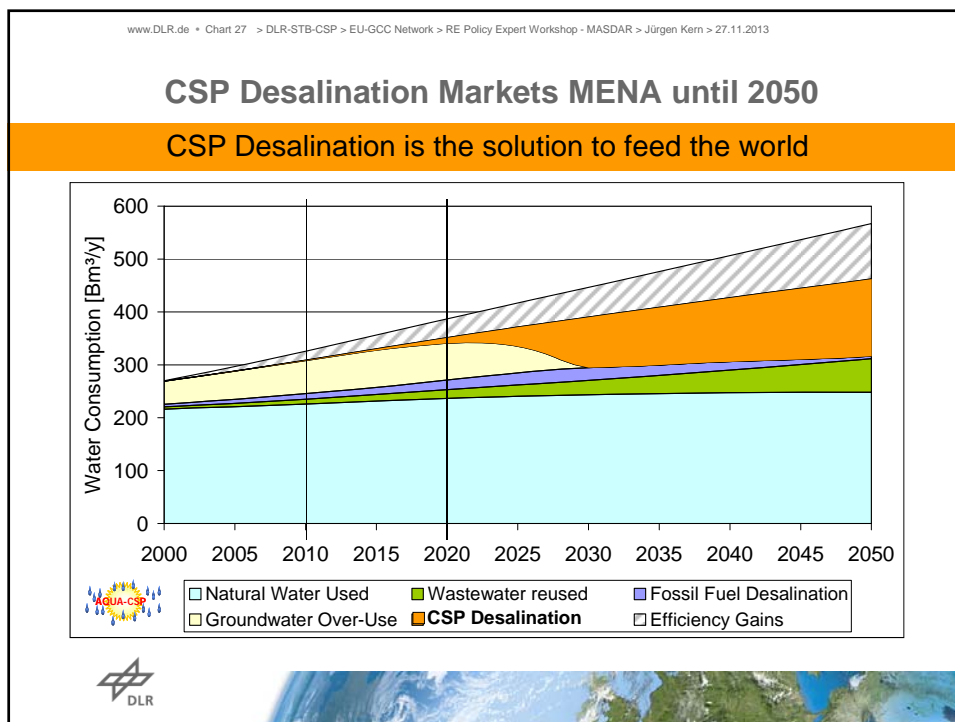
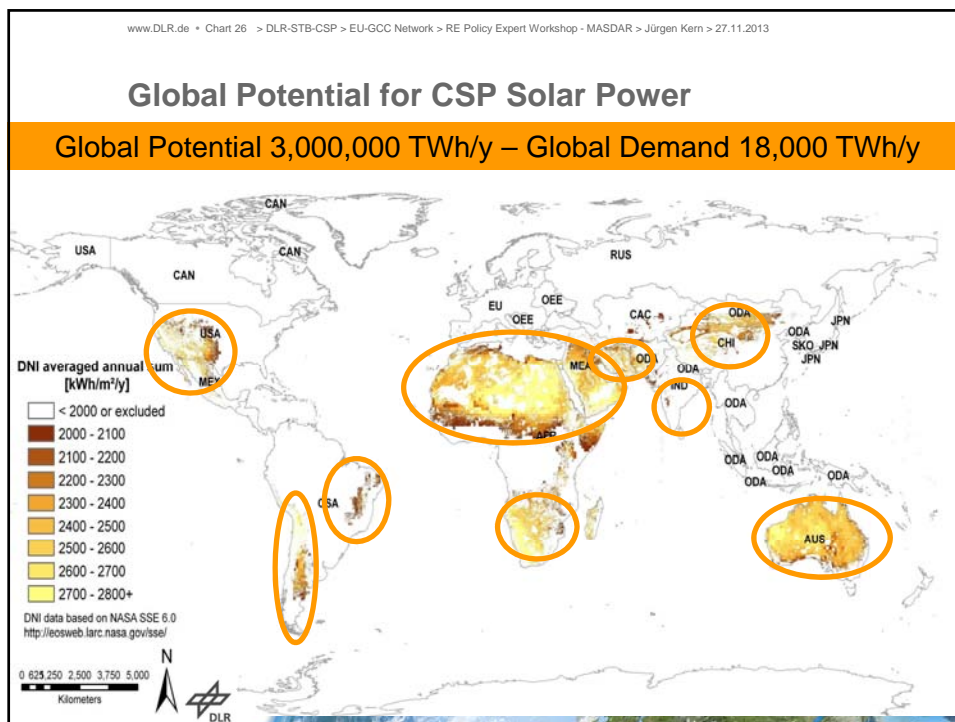


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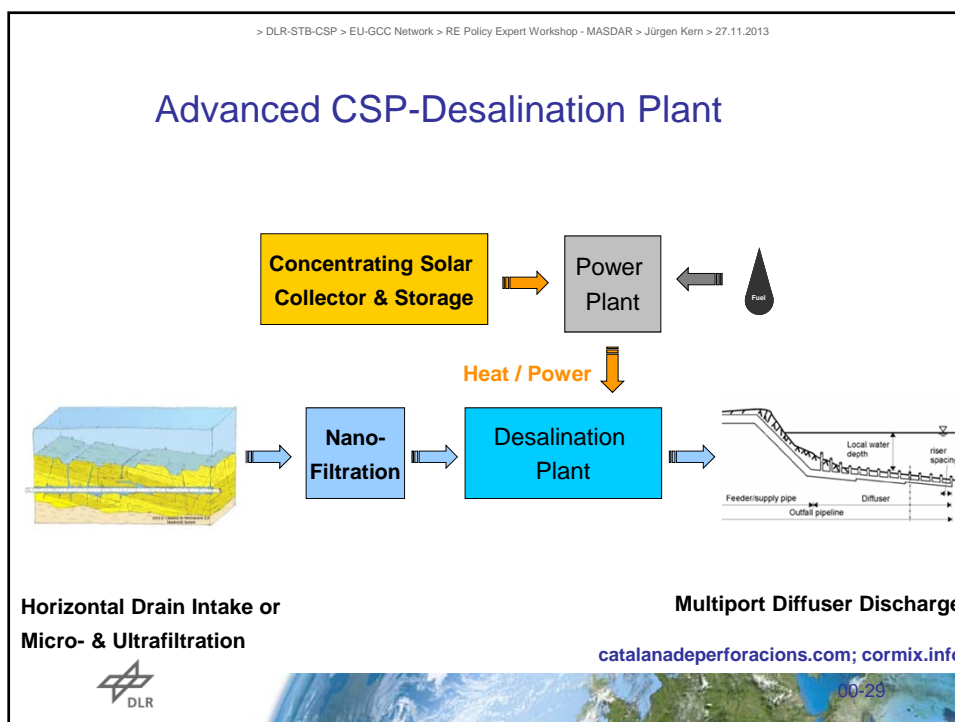
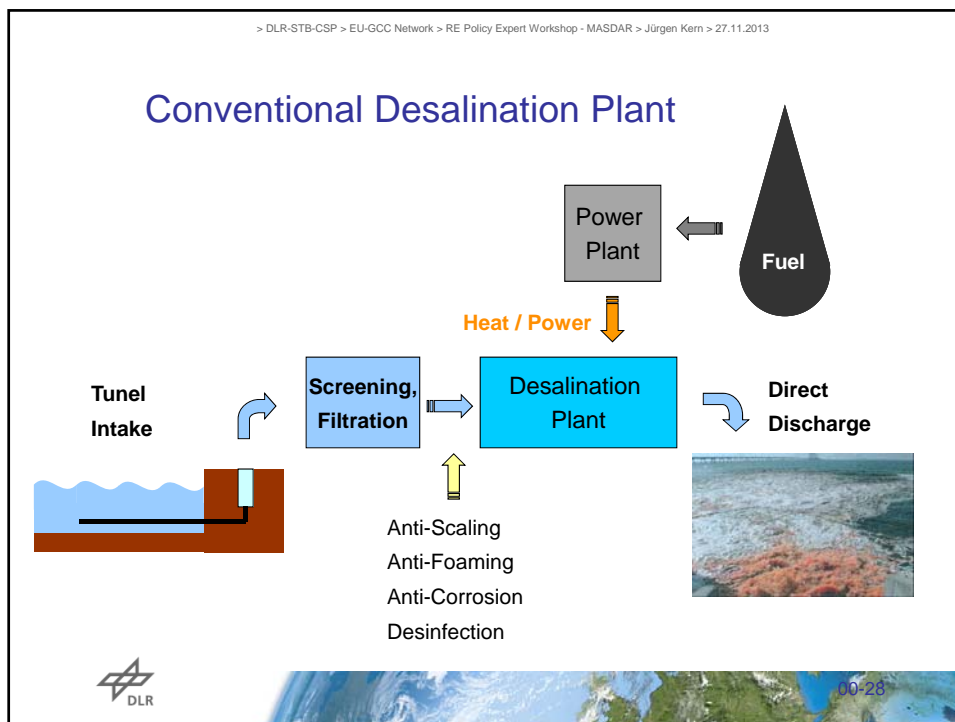
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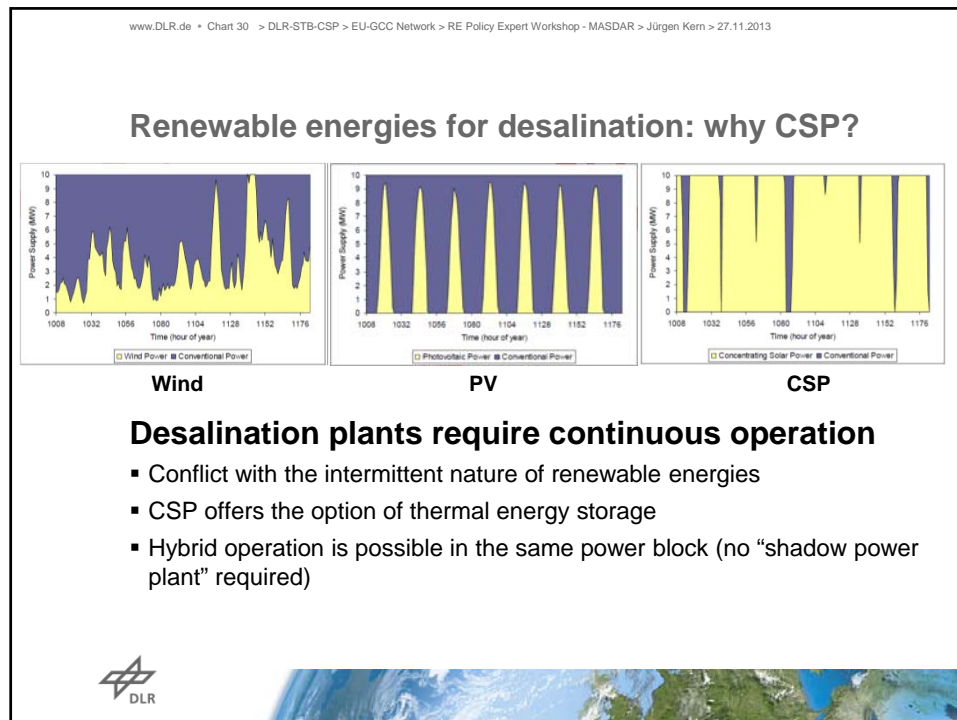
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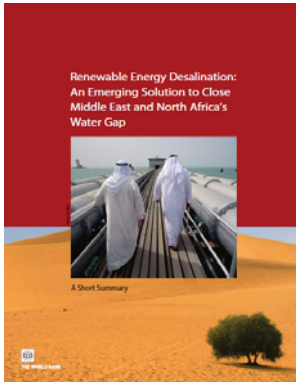
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## Publications

**The World Bank**



**Renewable Energy Desalination:  
An Emerging Solution to Close  
Middle East and North Africa's  
Water Gap**

**A Short Summary**

**[www.dlr.de/tt/menawater](http://www.dlr.de/tt/menawater)**

March 2011

**MENA Regional Water Outlook**

**Part II  
Desalination Using Renewable  
Energy**

**FINAL REPORT**



Task 1 - Desalination Potential  
Task 2 - Energy Requirement  
Task 3 - Concentrate Management

**FICHTNER**

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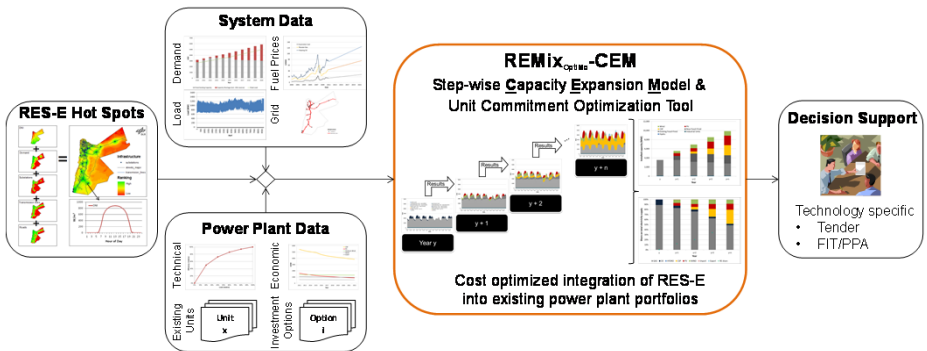


## Renewable Energy Expansion and Unit Commitment Model REM<sub>mix</sub>-CEM

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## Methodology for an optimized integration of RES-E technologies into existing power plant portfolios in MENA

- Emphasis on cost-optimized short-term integration of renewable energy systems for electricity generation (RES-E) and on security of supply
- Results for decision support for electricity authorities and power utilities in MENA

# EU-GCC Clean Energy Network

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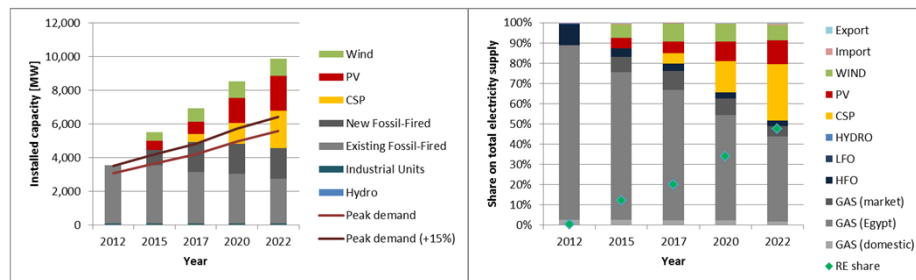
### Prospects for RES-E expansion in MENA

#### ReMix cost optimization model for capacity expansion

Example: Case study for Jordan

Jordan's situation:

- Strongly increasing electricity demand
- High dependency on fossil fuel imports



Scenario: „base case“



Source: Fichter (DLR) 2012, ReMix-MENA optimization tool

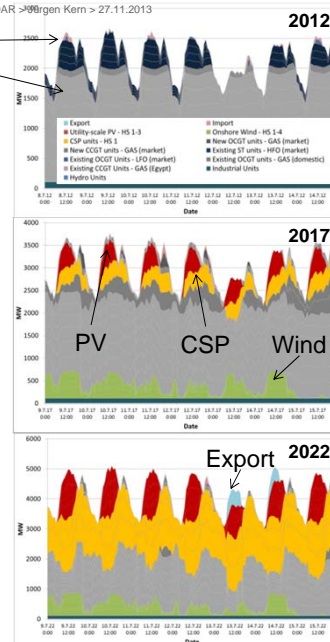
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### Business case MENA: Jordan

H.F.O. & L.F.O.  
N.G. Egypt

#### Strongly required firm and flexible renewable power capacity

- CSP competitive in the peak and upper-mid merit segment in the short-term.
- CSP providing strongly required **firm and flexible** power capacity.
- Very limited availability of electricity storage and of other flexible and firm RES-E.
- PV and Wind power as cheap “fuel saver”
- In the medium-term CSP competitive in mid-merit and base load segment.
- CSP in long-term as back-bone of electricity supply.



Source: Fichter (DLR) 2012, ReMix-MENA optimization tool

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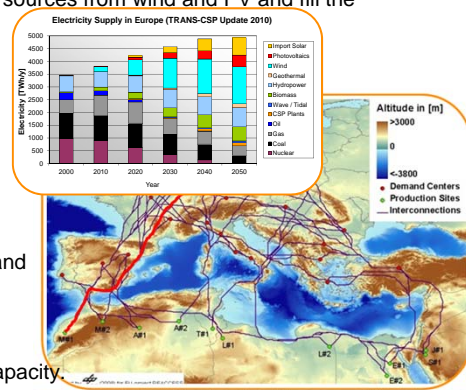
## Flexible, High Value Solar Power for Export



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## Solar Electricity Imports from MENA to EU (DLR Concept)

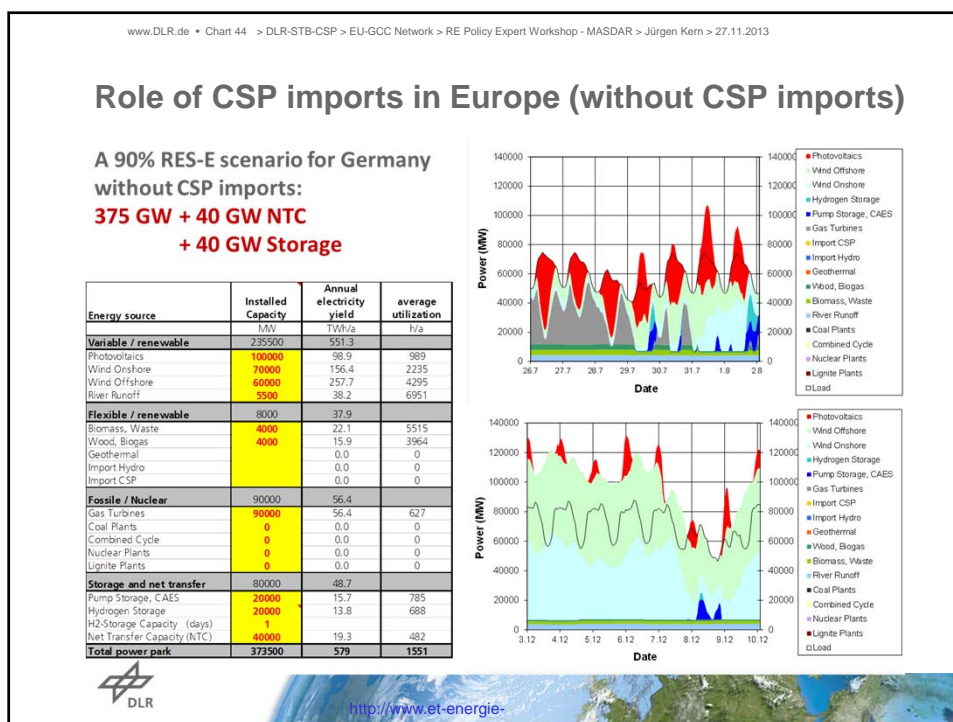
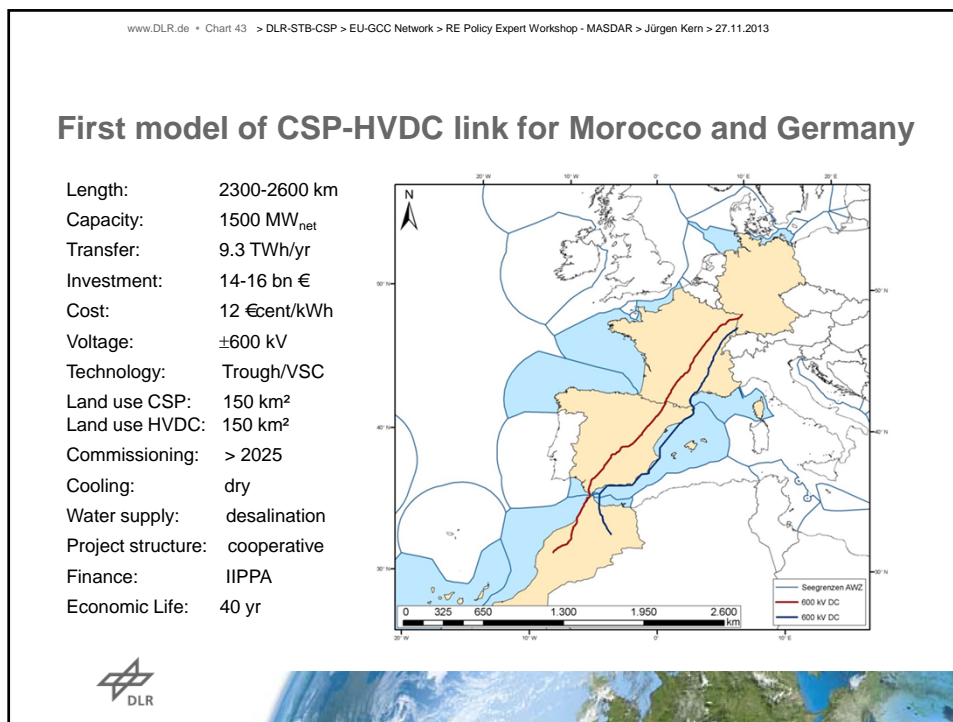
- Flexible solar power with firm capacity from CSP plants is transferred directly via point-to-point HVDC links from production sites in NA to European demand centers.
- CSP imports complement European sources from wind and PV and fill the remaining gaps.
- Export is not linked to or required for domestic demand in NA.
- Import capacity will always be lower than reserve capacity.
- About 40 HVDC links will provide 700 TWh/a (15% of demand) with 100 GW (7% of total) capacity.
- Point-to-point-links can be bundled and eventually interconnected to form a HVDC grid in the long term.
- CSP-HVDC links will reduce need for grid, storage and backup capacity.



Trieb et al., Energy Policy 42 (2012), 341–353.  
doi:10.1016/j.enpol.2011.11.091

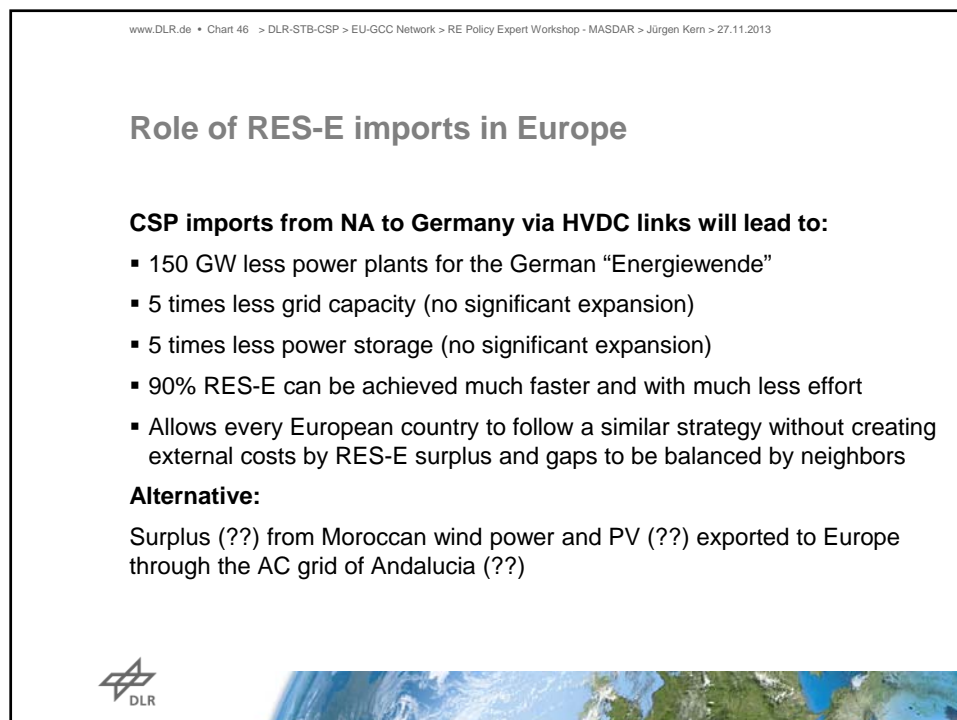
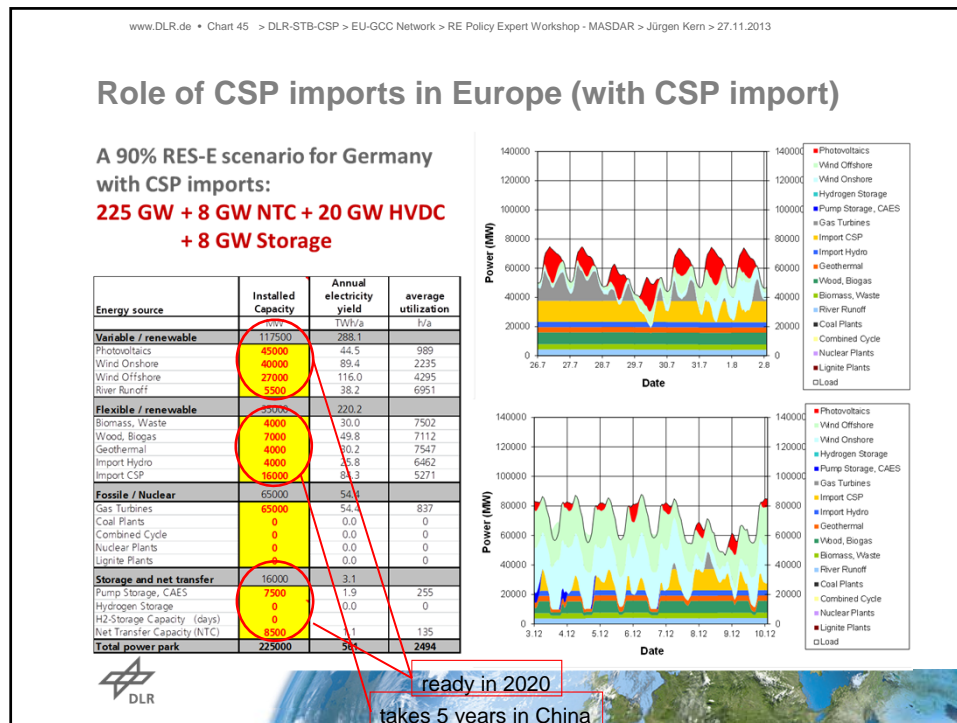
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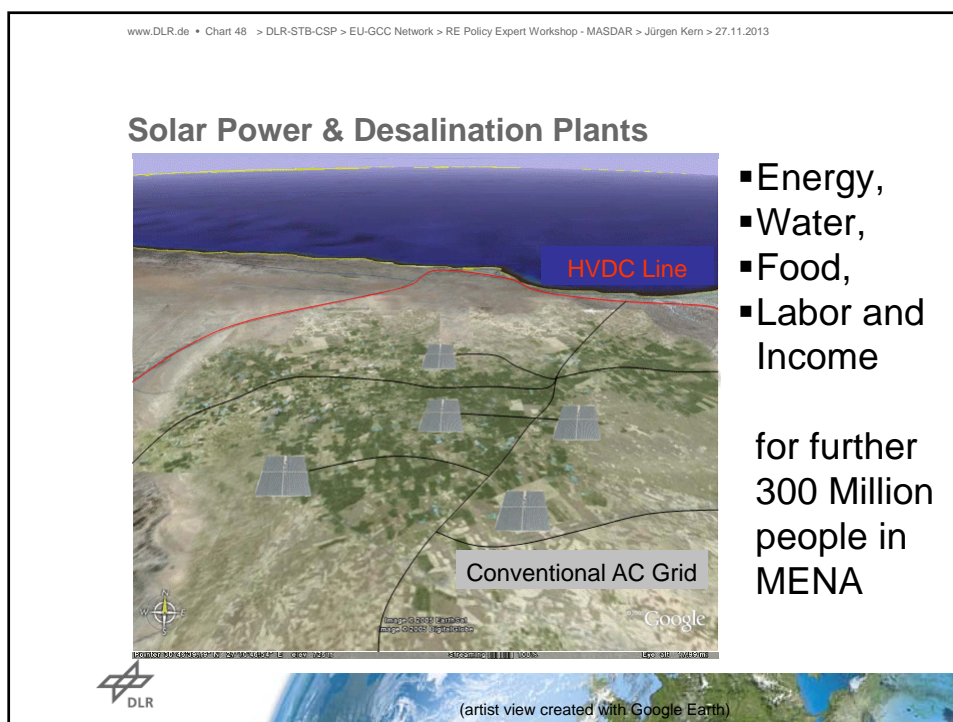
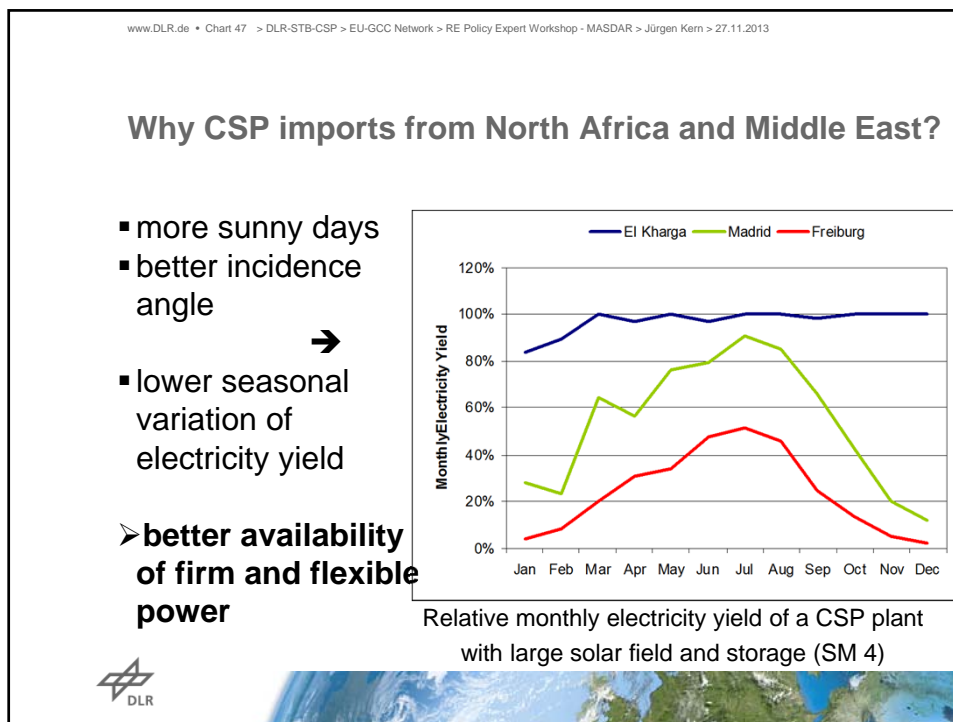


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## EU-GCC co-operation potential in the field of Renewables: Technology and Research perspective

### Fields of Activities



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### Fields of Activities for R&D in RE in EU-GCC

- Transformation of the Energy System towards Sustainability
- Seawater Desalination with Concentrating Solar Power
- Renewable Energy Resource and Site Assessment
- Renewable Energy Expansion and Unit Commitment Model REMix-CEM
- Technologie Development of Solar Thermal Power Plants
- Storage Technologies
- Flexible, High Value Solar Power Export
- Future Fuels: Hydrogen and synKWS



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## Selected publications

- MED-CSP [www.dlr.de/tt/med-csp](http://www.dlr.de/tt/med-csp)
- TRANS-CSP [www.dlr.de/tt/trans-csp](http://www.dlr.de/tt/trans-csp)
- AQUA-CSP [www.dlr.de/tt/aqua-csp](http://www.dlr.de/tt/aqua-csp)
- MED-CSD [www.med-csd-ec.eu/eng/](http://www.med-csd-ec.eu/eng/)
- MENA Regional Water Outlook [www.dlr.de/tt/menawater](http://www.dlr.de/tt/menawater)
- Financing concentrating solar power in the Middle East and North Africa – Subsidy or investments? Energy Policy 39 (2011) 307-317  
<http://dx.doi.org/10.1016/j.enpol.2010.09.045>
- Solar electricity imports from Middle East and North Africa to Europe  
Energy Policy 42 (2012) 341-353  
<http://dx.doi.org/10.1016/j.enpol.2011.11.091>



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